The Regenstrief Medical Record System (RMRS): Physician use for input and output and Web browser based computing

Authors: Clement J. McDonald M.D., J. Marc Overhage, M.D. Ph.D., William M. Tierney M.D., Paul Dexter, M.D., Greg Abernathy, M.D., Lisa Harris, M.D., Brenda Smith, R.N., Terry Hogan R.N,, Lonnie Blevins, Jill Warvel, Jeff Warvel, Jim Meeks-Johnson, Patrick Cassidy, Larry Lemmon, Tull Glazener, Anne Belsito, Don Lindberg, Mark Tucker

The Regenstrief Medical Record System (RMRS) is used at three hospitals on the Indiana University Medical Center campus, and more than thirty off-campus clinic sites. It also operates at Wilford Hall Medical Center and Brooks Army Base in San Antonio; Park Ridge in New York, Tidewater in Virginia, R. E. Thomason Hospital in El Paso, Texas, and other sites. More than 2000 medical center care providers use it to look at the 110 million observations for approximately 1.3 million distinct patients.

At Wishard Hospital and clinics, RMRS captures all clinical data with the exception of handwritten daily/visit notes. This includes institutional dictation (e.g., admission H&Ps, discharge summaries, operative notes, radiology and nuclear medicine reports, surgical pathology reports), as well as all diagnostic studies (OB ultrasound, cardiac echoes, EKGs, clinical laboratory, path- ology, electro-physiology, results), records of all medication from inpatient and outpatient encounters, billing diagnoses, and problem lists. Most of this information is stored in coded and computer retrievable formats. RMRS captures history and physical information in variable amounts from inpatient medicine wards. It captures vital signs (automatically), weights, I & O's, and bedside measures through bedside devices. The obstetrics service uses a series of paper question- naires to capture history and physical information at each phase of the pregnancy. Physicians at 12 homeless sites use portable PCs to enter their entire visit notes. Nurses on the wards capture their initial assessment data through radio-linked portable computers. RMRS also captures all administrative data, including detailed charge information.

We invest in manual entry to capture problem lists and key measurements obtained at clinic visits, and to record results from the ancillary services with small to moderate work volumes (EMG, EEG, cardiac caths). We use hard-wired interfaces from laboratory instruments, automated blood pressure machines, EKG carts, and unit dose dispensing machines. HL7 is used to communicate between independent computer systems and DICOM is used to access an image store.

Researchers and managers can retrieve patient data from the medical records system within seconds to minutes (depending upon the query), based upon the value of coded and numeric results.

Physicians on all services at Wishard Hospital enter all of their orders through the computer and do so happily for the most part. Pre-defined order sets, counter-detailing messages, and automatic reminders shape and unify the collective practice behavior of the institution's physicians. The PC- based order entry workstations also provide direct access to 180,000 EKG tracings, medical record flowsheets, reminders, and automated guidelines, as well as Medline retrievals through Grateful Med, online textbooks, and full text of ten years' worth of JAMA, Annals of Internal Medicine, and the New England Journal of Medicine.

We are linked to three hospital Emergency Departments (comprising almost two-thirds of the emergency room visits in Indianapolis), and a large pharmacy chain, to study the benefits of sharing clinical data for medical emergencies.

We have "wrapped" much of our legacy system in HTML/Web browser technology. Web provides us in one "easy" step a GUI interface, platform independence, easy deployment, security and much easier integration. For example, we link to an independent image store system seamlessly. Frames and JAVA-SCRIPT provide almost all of the fine control of interface design that we need. We are optimistic that this technology provides a practical path to health systems integration.

Supported in part by contract #N01-LM-4-3510, Nat'l Library of Medicine, and grant #R01 HS07719-01, AHCPR.